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NEXT REVIEW DATE: 2012
AUTH: HR 70-2
DATE 12/2/82 REVIEWER: [ ]

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16 MAR 1964

MEMORANDUM FOR: Chief, OXCART Division, OSA

SUBJECT: Fuel Computations in Flight Plans

1. This memo is intended as a matter of record for our mutual future reference concerning the problem of computing fuel on flight plans using the IBM 7090 Scientific Computer. A meeting on this subject was held in the OXCART Planning Room 10 March 1964. The following personnel were in attendance:

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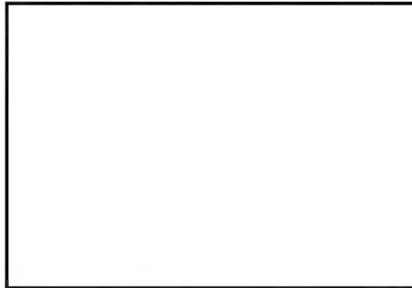
2. The main purpose of the meeting was to explore the problems of fuel computation using a matrix system of applying fuel curves in the computer. These problems became quite evident when Automation Division programmers started to work with the information supplied by the OXCART Division. Briefly there are four major problems:

a. There is a question of accuracy when information is extracted from fuel curves in SP-237A, placed in columnar form, then again extracted from this form to build a series of curves which in turn are converted to matrices to be programmed into the computer. This manual manipulation of data can easily produce errors to the magnitude of 2 - 5 per cent.

b. Programming of a series of matrices is time consuming, and changes in data will always necessitate considerable rework involving additional time consuming effort.

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c. A series of matrices in the magnitude envisioned to provide any profile required by the OXCART concept of operation will tax the capacity of the computer magnetic core storage unit to the absolute maximum, thus a read-in/read-out capability on magnetic tape must be programmed. This is not difficult or impossible, but will appreciably increase the computer running time for any individual flight plan. I don't believe this is too serious but should be recognized by all concerned.

d. Using a matrix system may very well usurp some of the prerogatives of the OXCART flight planners. For example: The parameters of altitude, geographical location, and flight profile cannot be given as an input package. Any two of the three can be given but the program must choose the third parameter. Insistence on inputting all three parameters will result in 'off-altitude' computation and the degree of 2 - 5% accuracy could never be guaranteed. This situation obviously would result in limitation of flexibility in the flight planning phase.

3. Considering the magnitude of the above problems, I feel an investigation of an alternate system of fuel computation is completely warranted. The other system I am aware of is the use of the thrust/drag, weight/lift ratio formulas. We have received a briefing on this system and its application in the flight simulation programs for the Air Force Command and Control System 473L. We are in the process of investigating the applicability of this system to the OXCART aircraft. I have set 24 March 1962 as the target date for completion of this evaluation by my programming staff. Immediately thereafter I will report our findings to you, and will make appropriate recommendations.

4. In the event we use the matrix system, the following general guides would apply:

a. The take-off, climb, descent and A/R fuel legs will be programmed as variable constants supplied as manual inputs from the OXCART flight planners. For example: Climb fuel for a climb to 85,000 feet is a constant. Likewise a climb to 70,000 feet is a constant. The variable factor is introduced by the selection of level-off altitude. The program then would interrogate the manual input of level-off and apply the correct fuel constant.

b. Using another example of climb, the manual input from the OXCART flight planner would include average mach, time or distance to level-off, and the base altitude, while the automated flight plan would provide the end altitude by using metro data from the Weather Section, and fuel used by gross weight and level-off interrogation of the constants table.

c. For flight altitudes the OXCART flight planners must provide:

    (1) Cruise climb (cc) and percent of after-burner, or

    (2) Cruise (cr) and altitude, or

    (3) Cruise (cr) and geographical points.

d. The flight plan program will provide geographical points for the case of paragraphs (1) and (2) above, and the altitude for the case in paragraph (3) above.

5. Obviously the implications of restraint on flexibility in the cases presented above must be given serious consideration. From my conversations with the personnel in the programming business at Strategic Air Command Headquarters, Omaha, Nebraska, I can authoritatively state they use the matrix system and have found the limitations outlined in paragraphs 2.b., c. and d. are in fact true, but not prohibitively complex to void making an effort to go in this direction.

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6. Recommend we plan a meeting for 24 March 1964 to further discuss this fuel programming problem.

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/s/

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